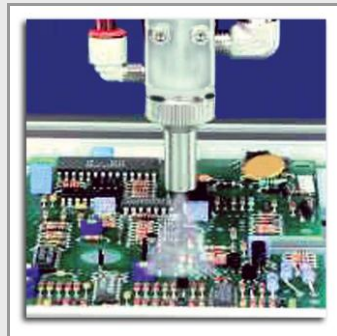
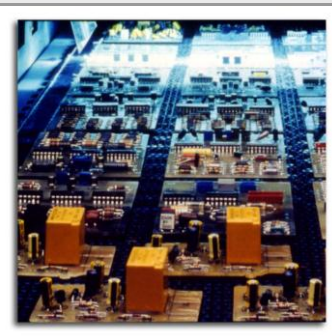
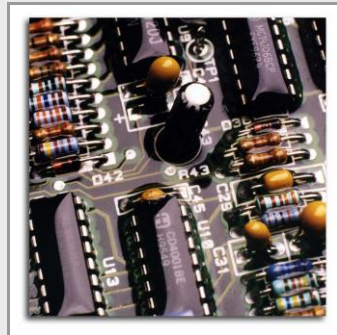
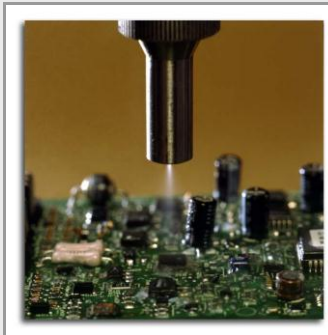
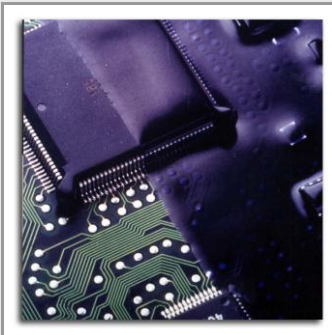
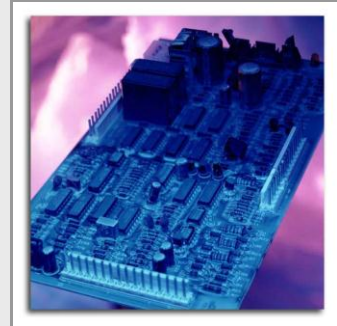
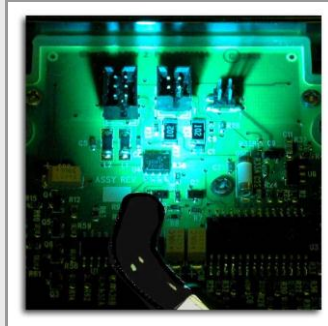
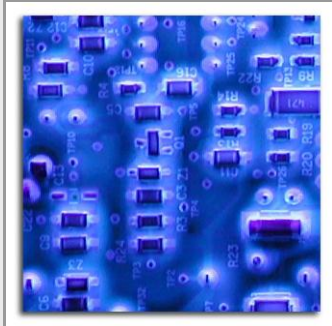


CONFORMAL COATINGS

for Electronic Circuit Protection



INTRODUCTION

DYMAX UV conformal coatings have been used to protect printed circuit boards for over twenty years in many high-reliability applications, including military, aerospace, medical, automotive, appliance, and telecom applications. Conformal coatings are often applied to printed circuit boards to improve circuit reliability in harsh environments. DYMAX light-curable conformal coatings are engineered to protect circuit boards from humidity, dust, fungus, and other contaminants that can cause either current leakage or corrosion.

WHY USE DYMAX UV CONFORMAL COATINGS?

SUPERIOR PROCESSING	SUPERIOR PROTECTION
<ul style="list-style-type: none">▪ Easier automation	<ul style="list-style-type: none">▪ IPC-CC-830, Mil-I-46058C, and UL listed
<ul style="list-style-type: none">▪ Full cure in seconds	<ul style="list-style-type: none">▪ Excellent environmental resistance
<ul style="list-style-type: none">▪ No racking, ovens, or humidity chambers	<ul style="list-style-type: none">▪ High dielectric strength
<ul style="list-style-type: none">▪ No risk of silicone migration	<ul style="list-style-type: none">▪ Tenacious adhesion to flex circuits
<ul style="list-style-type: none">▪ Solvent free	<ul style="list-style-type: none">▪ Low stress under thermal cycling
<ul style="list-style-type: none">▪ Most are Isocyanate free	<ul style="list-style-type: none">▪ Non-slumping viscosities
<ul style="list-style-type: none">▪ Thick coatings in a single application pass	<ul style="list-style-type: none">▪ Excellent abrasion resistance
<ul style="list-style-type: none">▪ Repairable	<ul style="list-style-type: none">▪ Black coatings help hide proprietary circuitry
<ul style="list-style-type: none">▪ One part, no mixing or viscosity problems	<ul style="list-style-type: none">▪ Protection up to 175°C

SELECTING A DYMAX CONFORMAL COATING

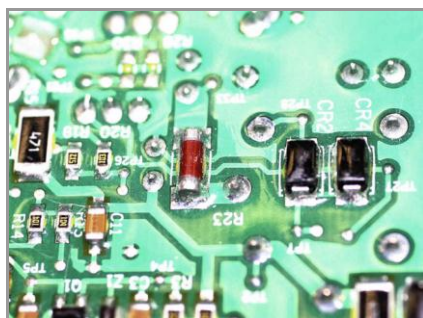
WHEN SELECTING A UV CURABLE CONFORMAL COATING, THERE ARE THREE MAIN THINGS TO CONSIDER:

1. *Coating Application and Curing*
2. *Coating Adhesion to PCB and Assembly Materials*
3. *Coating Properties and Specifications*

COATING APPLICATION AND CURING:

Typically, the best way to apply DYMAX conformal coatings is by selective spray application. This method ensures that areas which must be protected are coated at the desired thickness and areas which should not be coated remain uncoated. In addition, selective spray application can be used to avoid depositing the UV coating underneath components where the material is shadowed from light.

DYMAX conformal coatings cure in seconds under high-intensity UVA and blue visible light. With proper coating application, UV cure is a very simple processing step. The application of UV conformal coatings is discussed more fully on page four of this guide. Details and recommendations are provided on page five of this guide.



COATING ADHESION TO PCB AND COMPONENT MATERIALS:

To provide effective protection to PCB components and surfaces, conformal coatings must wet well upon application and adhere well after cure. Optimal results are obtained with clean boards.

CURED COATING PROPERTIES AND SPECIFICATIONS:

DYMAX conformal coatings are excellent insulators. In practice, properties affecting the degree of protection include coating thickness (thicker is typically better), moisture absorption (less is better), and resistance to other environmental stresses. Flexible grades are designed to enhance thermal cycling performance. Hard, more rigid grades are preferred to enhance chemical resistance in harsh environments. Required specifications are also important considerations. DYMAX conformal coatings are used in a multitude of military and automotive applications. DYMAX carries an array of MIL-I-46058C listed, IPC-CC-830-B approved and UL recognized coatings.



CONFORMAL COATINGS

RELIABLE BOARD PROTECTION IN SECONDS

Product Number*	Description	Viscosity (cP)	Durometer Hardness	Modulus of Elasticity (psi)	Dielectric Strength (Volts/mil) ¹	Approvals
9481-E	Secondary moisture cure for shadowed areas; low viscosity for thin coatings; low surface energy for difficult-to-wet components and assembly materials; high chemical and abrasion resistance	125	D75	21,800	>1,500	MIL-I-46058C listed IPC-CC-830B approved UL recognized
984-LVUF	Secondary heat cure; Isocyanate free; low viscosity for thin coatings; rigid for high chemical and abrasion resistance	150	D80	60,000	1,800 @ 2 mil	MIL-I-46058 listed IPC-CC-830 approved UL recognized
987	Secondary heat cure; Isocyanate free; low viscosity for thin coatings; rigid for high chemical and abrasion resistance; low surface energy for difficult-to-wet components and assembly materials	150	D85	130,000	>1,500	MIL-I-46058 listed IPC-CC-830 approved
9-20351-UR	Secondary heat cure; Isocyanate free; high viscosity for easy one-pass coverage of high-profile leads and tall components; low modulus for superior thermal cycling performance; red fluorescing	14,000	D60	2,700	>500	-
9-20557	Secondary heat cure for shadowed areas; Isocyanate free; medium viscosity for wetting components; low modulus for enhanced thermal cycling performance	2,000	D60	35,000	1,200 @ 2 mil	MIL-I-46058C listed IPC-CC-830 approved UL recognized
9-20557-LV	Secondary heat cure for shadowed areas; Isocyanate free; low viscosity for thin coatings; low modulus for enhanced thermal cycling performance	850	D70	35,000	>1,500	MIL-I-46058C listed IPC-CC-830 approved

*NOTE: Other grades are available for specific applications requiring physical properties that are different from the standard products listed here.

¹ 1-mil = 0.001 in = 0.0254 mm

SELECTIVE SPRAYING OF UV CURABLE CONFORMAL COATINGS

The effectiveness of a conformal coating is dependent upon how well it is applied. The most effective method of applying a UV conformal coating is selective spraying. Selective spraying allows for sufficient coverage of all areas that require coating while avoiding those areas that must not be coated. Selective spraying is typically accomplished with three- or four-axis robotic systems.

In designing and operating a selective-coating system, there are several key factors to consider. These include the pressure pot, fluid lines, application equipment/process, and the compatibility of the coating with all wetted surfaces. Most importantly, the accuracy of the spray pattern desired should be considered in choosing a spray system to avoid coating application in shadow areas.

PRESSURE POT

One of the first steps in designing a selective-coating operation is to determine the appropriate coating package size and corresponding pressure pot. Most customers purchase DYMAX conformal coatings in 1-liter bottles or 15-liter pails. In most cases, DYMAX conformal coatings are stable in sealed pressure pots for extended periods of time (6 months or more).

FLUID LINES

UV curable coatings can react in the presence of fluorescent overhead lighting. Black, opaque fluid lines will prevent curing in the fluid lines. Opaque polyethylene, polypropylene, or Teflon[®] fluid lines are typically recommended to ensure material compatibility.

APPLICATION PROCESS

Conformal coating resins can be applied using simple hand-application equipment, but are most commonly applied using robotic selective-spray systems. Selective-spray methods include either atomized or non-atomized spray techniques. An atomized process utilizes air to produce a fine mist. A non-atomized process is air free and relies on a variety of spray pattern designs to produce a uniform film. The technology is ideal for lower viscosity formulations.

Selective-spray pattern widths can vary from 0.125" to over 2" and are highly dependent upon the height of the applicator from the work surface. A thickness of 0.002" or greater can be achieved in a single pass. Coating thickness is controlled by robot speed and a flow regulator on the spray valve.



Aside from the obvious quality and repeatability benefits, robotic application aims to eliminate manual masking operations. The success or failure of satisfying this objective lay not just with the applicator, but on the capability of the robot itself. It is critical to explore the necessary axes of motion required to meet your objectives. Two-, three-, and four-axis robots are available to access all necessary coating areas while avoiding keep-out areas. In areas where a spray valve alone either can't access an area or covers too much area, a separate needle dispensing valve (with optional tilt) can be incorporated into the selective-coating system.

COMPATIBILITY OF DYMAX COATINGS WITH DISPENSING EQUIPMENT MATERIALS

DYMAX conformal coatings are readily dispensed through a wide variety of commercially available spray valves, pressure pots, and pail/drum ram pumps (for thicker coatings). When selecting a dispensing system, make sure that wetted equipment materials are compatible with DYMAX products. Incompatible wetted components can be attacked by DYMAX coatings or may cure prematurely.

Recommended Materials for Dispensing Equipment:	
Acetals	Nylon (pure)
Hard Chrome	Opaque Teflon®
Opaque HDPE, HDPP*	Stainless Steel (300 series, non-magnetic)
Opaque Silicone	
Common Materials to Avoid in Dispensing Equipment:	
Aluminum	N-Butyl "O" Rings
Brass	Polycarbonate
Bronze	Polyurethane
Cast Iron	PVC
Copper	Stainless Steel (400 series, magnetic)
Mild Steel	Zinc

**Not recommended in Darc Cure® Systems*

CURING DYMAX CONFORMAL COATINGS

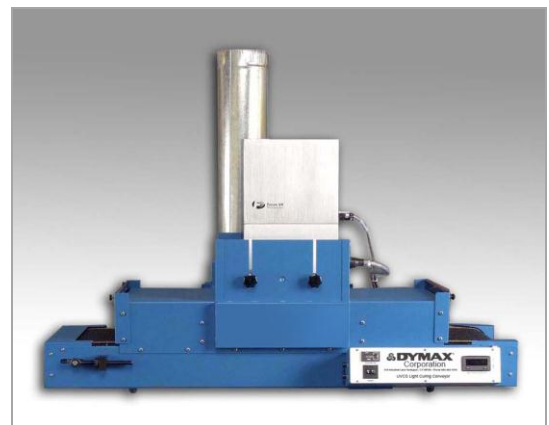
The following are important guidelines when selecting a light source for curing a DYMAX conformal coating:

Your success with UV curable conformal coatings is partly dependent on the curing system employed. In general, higher-intensity lamps yield faster, more efficient cures and better overall performance.

HIGH-INTENSITY LIGHT SOURCES FOR UV CURABLE CONFORMAL COATINGS

There are two basic types of light sources that can be used for curing UV curable conformal coatings. DYMAX supplies both types.

1. **Mercury Arc Lamps** – This type of light source typically provides 50-1000 mW/cm² of UVA light at the curing surface. The major advantage of these systems is lower capital cost. Bulb degradation must be monitored with a radiometer to ensure a controlled process. These systems are appropriate for lower-volume applications where conveyor speeds of 1 to 5 feet per minute are acceptable.
2. **Electrodeless Lamps** – This type of light source generally provides 1000 - 3000 mW/cm² of UVA light at the curing surface. The major advantages of these systems are faster cure and higher throughput. While capital costs are higher, total cost of ownership is lower due to longer bulb life, less maintenance, and better energy efficiency. They are recommended for medium- to high-volume applications.



ESTABLISHING A CONTROLLED CURE PROCESS

Guidelines for establishing a controlled UV cure process are discussed in the DYMAX **Comprehensive Guide to UV Light-Curing Technology** (available at www.dymax.com or by contacting DYMAX Applications Engineering at 877-396-2988).



Curing consistency is maintained by following these simple steps:

1. Establish the lower limit lamp intensity/energy needed for curing your part in your specified time frame. This step requires a radiometer.
2. If using mercury arc lamps, choose a lamp system and process settings such that a new bulb provides 3-4 times the energy required for your process. If using electrodeless lamps, choose process settings (exposure time or conveyor belt speed) such that a new bulb provides 2-3 times the energy required for your process.
3. Monitor lamp output with a radiometer and change the bulbs when they approach the established energy limit of your process.

SECONDARY HEAT CURE

Where significant deposition of UV conformal coating occurs in shadow areas, a secondary heat application step can be used to affect cure in those shadow areas. Recommended cure schedules are 110°C for 1 hour or 120°C for 30 minutes.

SECONDARY MOISTURE CURE

DYMAX 9481-E cures primarily with light but also has the ability to cure with moisture in shadowed areas. Heating boards in an oven or exposing to higher relative humidity after coating will accelerate moisture curing of shadow areas.

REWORK AND REMOVAL OF UV CONFORMAL COATINGS

INTRODUCTION

The purpose of conformal coatings is to protect PCBs and components from environmental attack or stress. They function by adhering tenaciously to PCB/solder/component surfaces through environmental stresses such as humidity and water exposure, chemical and particulate exposure, and heat and cold. The same properties that make a conformal coating a good protecting coating make its removal more difficult.

In general, solvent-based, non cross-linked varnish-like coatings (not supplied by DYMAX) will be relatively easy to remove with solvents. Other chemistries with relatively low adhesion to electronic surfaces, particularly silicones, can be removed mechanically. DYMAX UV conformal coatings are cross-linked coatings that are designed to form strong bonds to electronic surfaces. Therefore, somewhat more aggressive removal strategies are required for rework compared to solvent-based systems and silicones.

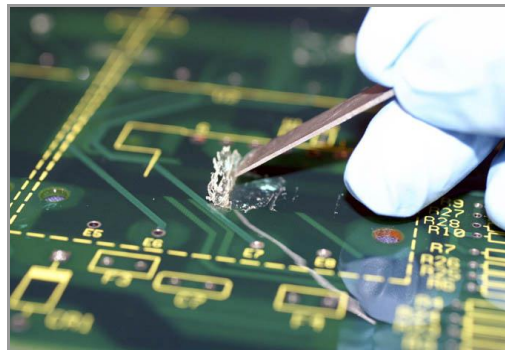
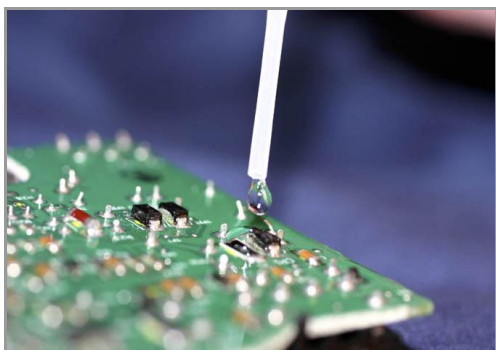
CHEMICAL REMOVAL

Removing cured conformal coatings by chemical treatment requires immersion of the coated board or treating localized areas with the chemical stripping solution. Several companies manufacture materials which dissolve/attack cross-linked conformal coatings. Suppliers of these materials can recommend handling procedures. The list at the top of page 7 includes some suppliers of coating removal solvents.

CHEMICAL REMOVER SUPPLIERS

COMPANY	PRODUCT	TELEPHONE NUMBER	WEB SITE
Savogran Corporation 259 Lenox Street Norwood, MA 02062	Kutzit or Strypeeze <i>Products are sold through local, paint, hardware, and home centers.</i>	800-225-9872	www.savogran.com
Dynaloy, Inc. 1535 E. Naomi Street Indianapolis, IN 46203	Dynasolve Uresolve Plus SG <i>Products are sold through authorized distributors.</i>	800-669-5709 317-788-5694	www.dynaloy.com
Tech-Spray 1001 N.W. 1 st Avenue P.O. Box 949 Amarillo, TX 79105 <i>(for street address use 79107)</i>	Fine-L-Kote Remover 2510 <i>Products are sold through authorized distributors.</i>	800-858-4043	www.techspray.com
Jasco, Inc. 1008 N. Fuller Street Santa Ana, CA 92701	Jasco Premium Paint and Epoxy Remover <i>Products are sold through local paint, hardware, and home centers and distribution.</i>	888-345-2726	www.jasco-help.com

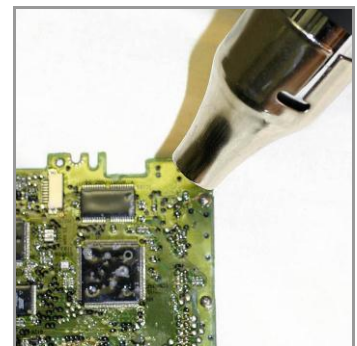
NOTE: It is important to consult with your company's health and safety department prior to using any of these products. DYNAMAX lists the above products for conformal coating removal, but no claims or warranties are implied regarding their effectiveness for specific applications.



HEAT REMOVAL

Two techniques are useful for removing cured conformal coating depending upon the temperature sensitivity of the components present on the circuit board.

1. For heat-sensitive areas requiring repair, heat the entire board to 150° C and mechanically strip the coating as it softens while still hot.
2. For repairing areas not particularly sensitive to temperature, use a hot-air de-soldering tool or a solder gun to remove spot coatings. Apply the heat source to the treatment area and remove coating as it softens.



MECHANICAL REMOVAL

Comco, Inc. 2151 N. Lincoln Street Burbank, CA 91504-3344	800-796-6626 818-841-5500 www.comcoinc.com	<i>The company manufactures a Micro-Blaster System that safely removes cured coating with a pressurized abrasive. The abrasive is easily removed from the surfaces without danger to the components or reworking process.</i>
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DYMAX CONFORMAL COATING APPROVALS

MIL-I-46058C Listed	IPC-CC-830 Approved	UL Recognized
9481-E	9481-E	9481-E
984-LVUF	984-LVUF	984-LVUF
987	987	9-20557
9-20557	9-20557	
9-20557-LV	9-20557-LV	

FILM COVERAGE

1 Liter of DYMAX coating will cover the following areas at the film thicknesses shown:

Thickness	Square Feet
0.001"	343
0.002"	173
0.003"	114
0.004"	86
0.005"	68
0.010"	34

Note: The figures shown above assume the total use of a liter of adhesive without any allowance for waste, over-spray, or any other unused amount.

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